

## INTRODUCTION

On April 26, 2001, cultureable fungal air sampling was conducted in various locations on the 6<sup>th</sup> and the 14<sup>th</sup> - 19<sup>th</sup> floors at the facility located at 25 Sigourney Street in Hartford, CT. The sampling was conducted by Occupational Risk Control Services, Inc. The purpose of the sampling was to determine if there were elevated levels of cultureable fungal spores in areas where occupants were experiencing symptoms. General indoor air quality measurements, such as temperature, relative humidity, carbon dioxide, and carbon monoxide were also taken during the sampling.

## RESULTS

### Temperature and Relative Humidity

Temperature and relative humidity monitoring was conducted in twenty four (24) locations in various zones on the 6<sup>th</sup>, 14<sup>th</sup>, 15<sup>th</sup>, 16<sup>th</sup>, 17<sup>th</sup>, 18<sup>th</sup>, and 19<sup>th</sup> floors of 25 Sigourney Street. During the warmer months, the American Society of Heating, Ventilating, and Air Conditioning Engineers (ASHRAE) recommends that the temperature inside buildings range from 72.5° to 80°F. All locations monitored were within this recommended temperature range. Temperature measurements are included in Appendix A.

ASHRAE also recommends that the relative humidity within buildings range from 30-60%. All areas within the building were below this recommended range. Although the relative humidity levels were not within the ASHRAE recommended guidelines, we do not recommend installation of humidification systems for this building. Relative humidity measurements are included in Appendix A.

### Carbon Dioxide

Carbon dioxide monitoring was conducted outside the building and in the same twenty four (24) locations that temperature and relative humidity were monitored. The carbon dioxide level outside ranged from 400 to 425 parts per million (ppm). ASHRAE recommends that indoor levels should not be more than 700 parts per million (ppm) above the outside levels of carbon dioxide. Therefore, based upon the ASHRAE guidelines, the recommended carbon dioxide level range for this building would be 1,100 to 1,125 ppm. All of the areas monitored for carbon dioxide were within the recommended levels. The carbon dioxide results are included in Appendix A.

### Carbon Monoxide

Carbon monoxide was monitored outside and in the same twenty four (24) locations inside the building. Carbon monoxide was not detected in the building on the day of the survey. Results are also included in Appendix A.

## **Cultureable Fungal Air Sampling**

Cultureable fungal air sampling was conducted in both the morning and the afternoon in twenty four locations inside the building and outside. The results of the cultureable fungal air samples are included in Appendix B.

The levels of cultureable fungal spores were low for all 48 of the inside samples when compared with the results of the three (3) outside samples. No cultureable fungal spores were found in 25 of the 48 samples collected inside and all of the cultureable fungal spore levels for the inside samples were 40% or less than the outside levels.

Eight (8) of the 48 samples taken inside had species that were not found outside. Fungal species found inside but not outside may indicate fungal growth inside although yeasts which can be associated with human occupancy were found in five (5) of these eight (8) samples. The remaining three (3) samples had species of *Syncephalastrum*, *Mucor*, and *Memnoniella* which indicates possible moisture incursion. The yeasts and other three (3) species found in the inside samples and not in the outside samples were at low levels.

## **DISCUSSION**

### **Cultureable Fungal Spore Air Sampling**

The purpose of the sampling was to monitor the cultureable fungal spore levels in the building. The sample plan was developed to perform cultureable fungal spore monitoring in areas inside the building where occupant complaints had been reported. Symptom logs and occupant complaints reported to Tunxis Management and the Connecticut Department of Public Works (DPW) as of April 25<sup>th</sup>, 2001 was used to select the sample locations.

Since there are no federal or state regulations regarding indoor fungal spore levels, samples of outside air are taken to be used for comparison purposes. Generally, in buildings with a mechanical filtration system, fungal spore levels should be less than outdoor levels. Also, the species rank order should be similar. When fungal spore levels are higher indoors than outdoors, or when the species rank order is dissimilar, there may be a fungal growth source within the building.

The results indicate that the cultureable fungal spore levels in all of the indoor samples were less than the outdoor levels. All but two (2) inside sample locations contained less than 20% of the outside cultureable fungal spore levels. The remaining two (2) locations contained approximately 40% of the outside cultureable fungal spore levels. Ranking the order of fungal species could not be used as an evaluation tool because the number of cultureable fungal species and the spore levels were so low.

Based upon our sample results from this survey, it appears the filters used for the air handling units are providing good air filtration and assisting with maintaining the cultureable fungal spore levels inside lower than outdoor air. The results indicate, however, that there are some species

present in the inside samples that are not present in the outside samples. This may indicate that a fungal source, such as carpet dust or plant soil, is present in those areas within the building. Although four (4) fungal species not found outside were identified in eight (8) of the 48 indoor samples, the concentration was low in each sample.

## CONCLUSIONS

Cultureable fungal spore levels inside the building from this and previous air monitoring surveys were not elevated when compared to outdoor levels. Some species of fungi found inside were not present in outside samples for previous air monitoring surveys which indicated fungal growth inside the building. Wallboard along the perimeter of the building that was exposed to repeated moisture incursion was identified as a fungal reservoir. Our original hypothesis was that the wetted wallboard was responsible for occupant symptoms.

Most of the wallboard remediation was completed in the fall of 2000 and results of cultureable fungal spore levels from the past two (2) surveys since the remediation continue to have low cultureable fungal spore levels. The number of fungal species found inside but not outside has also been reduced since the wallboard remediation but occupant symptoms continue to be reported.

We now believe that factors other than exposure to cultureable fungal spores may be contributing to symptoms. Other compounds generated by microbial growth such as endotoxins in gram negative bacteria may be contributing to occupant symptoms. Carpeting in areas that were repeatedly exposed to moisture were found to have high levels of gram negative bacteria. A program is being implemented to remove these carpets and until the carpets are removed, occupant symptoms may persist.

Occupants identified by medical professionals with building related symptoms should continue to use the symptom logs. Focus can then be placed on these individuals and the areas where they work in to identify possible causes of symptoms. Completing the symptom logs will also assist us in determining any patterns that may exist in the building. Review of the symptom logs can also assist in developing hypotheses to identify possible relationships between symptoms reported and the building's indoor air quality.

## RECOMMENDATIONS

### 1. Provide the results of this report to facility occupants.

It is important that persons working in the areas monitored on the 6<sup>th</sup> and the 14<sup>th</sup>-19<sup>th</sup> floors and other interested occupants are kept informed of the results of this survey. Information should include results of monitoring, remediation efforts, and follow-up procedures. Informational meetings should be held with building occupants and feedback should be encouraged.

**2. Continue having occupants identified with building related illnesses complete the symptom logs.**

A total of 41 individuals have stated they are now experiencing problems they feel are related to the air quality of the building. Results of occupant medical evaluations by an occupational health clinic should help to determine if the building occupant symptoms are building-related. Focus can then be placed on those individuals and areas where they work to identify possible symptom causes.

The information included in the symptom logs can provide important information on identifying locations (i.e. around perimeter) and frequency (i.e. after rain) of symptoms. It is important that the information is reviewed, hypotheses are developed as to identify possible cause(s), and follow-up measures are taken to prove or disprove the hypotheses.

**3. Remove carpeting that has been identified as being a microbial reservoir.**

A carpet replacement program has been initiated for the 17<sup>th</sup> floor. We also recommend that carpeting on other floors such as the 15<sup>th</sup>, 18<sup>th</sup>, and 19<sup>th</sup> floors that have been repeatedly wetted or allowed to remain wet for more than two (2) days be included in the carpet replacement program. Measures to restrict microbial spore dispersion during carpet removal have been developed and should be used when the carpeting is removed.

## **METHODS**

The carbon dioxide measurements were conducted according to the Occupational Risk Control Services, Inc. Method No. 1. The carbon dioxide levels were monitored using a TSI Q-Trak Model 8551 (Serial No. 30295) monitor and a Metrosonics AQ-5000. The instruments measure carbon dioxide levels using non-dispersive infrared absorption (NDIR). Both meters have a detection range of 0 to 5,000 parts of carbon dioxide per million parts of air (ppm) with a +/- 1 ppm sensitivity. The monitors were calibrated prior to the survey using a calibration gas mixture. Monitoring results were collected after conditioning the monitor sensors to the environment and readings were stable.

The cultureable fungal air samples were collected following ORCS IAQ Method No. 2. The cultureable fungal air samples were delivered to P & K Microbiology Services, Inc. located in Cherry Hill, NJ for analysis. P & K Microbiology Services, Inc. is an Environmental Microbiology Laboratory Accreditation Program (EMLAP) accredited laboratory.

An effort was made to provide a professional evaluation of indoor air quality exposures. It must be noted there are inherent limitations to any survey project. These limitations may be due to time constraints, operational and work practice variability, and seasonal conditions. The results of this survey are representative of conditions present on the day of the survey. Conditions or operations not evaluated, or reported on, should not be assumed to be without risk.

# Appendix A

## Carbon Dioxide, Carbon Monoxide, Temperature, and Relative Humidity Measurements

25 Sigourney Street  
Hartford, CT

April 26, 2001

LOCATION	SAMPLE TIME	CARBON DIOXIDE (ppm)	TEMP (°F)	RELATIVE HUMIDITY	CARBON MONOXIDE (ppm)	OCCUPANCY	COMMENTS
Outside	10:18a 1:40p	400 425	61 68	27 15	1 <1	N/A	On roof
16 <sup>th</sup> Floor Zone 3	10:40a 2:00p	750 725	73 75	27 22	<1 <1	1 1	Employee coughing Carpeted; hallways not
16 <sup>th</sup> Floor Zone 4	10:52 2:14	700 725	74 75	23 20	<1 <1	3 3	Open area; carpeted
16 <sup>th</sup> Floor Zone 5	11:08 2:21	600 675	74 75	21 18	<1 <1	1 0	Edge of work area into hallway carpeted
16 <sup>th</sup> Floor Zone 7	11:17 2:29	550 600	75 75	20 19	<1 <1	0 2	Carpeted
15 <sup>th</sup> Floor Zone 6	11:26 2:37	750 800	74 74	23 21	<1 <1	3 3	People located on side of cubicles; carpeted
15 <sup>th</sup> Floor Zone 7	11:36 2:47	800 800	74 74	25 22	<1 <1	3 3	Carpeted
14 <sup>th</sup> Floor Cove	11:49 2:59	825 775	74 73	26 23	<1 <1	1 0	Carpeted near conference room
14 <sup>th</sup> Floor Zone 5	11:55 3:06	850 750	75 74	25 22	<1 <1	2 2	Carpeted
14 <sup>th</sup> Floor Zone 7	12:04 3:13	700 700	75 74	22 22	<1 <1	0 1	Carpeted room used to have walls; recently removed

# Appendix A Continued

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LOCATION	SAMPLE TIME	CARBON DIOXIDE (ppm)	TEMP (°F)	RELATIVE HUMIDITY	CARBON MONOXIDE (ppm)	OCCUPANCY	COMMENTS
6 <sup>th</sup> Floor Zone 1	12:15 3:25	825 825	75 75	23 22	<1 <1	0 3	Carpeted
6 <sup>th</sup> Floor Zone 5	12:30 3:35	775 800	75 74	23 22	<1 <1	0 1	Carpeted
Outside	3:51	425	69	17	<1	N/A	Sunny; slightly hazy
19 <sup>th</sup> Floor Zone 7	10:24 1:54	650 675	74 73	25 22	<1 <1	3 5	Carpeted
19 <sup>th</sup> Floor Zone 1	10:34 2:03	750 625	74 73	23 22	<1 <1	1 4	Carpeted
19 <sup>th</sup> Floor Zone 3/4	10:45 2:13	675 650	74 74	23 22	<1 <1	2 4	Carpeted
18 <sup>th</sup> Floor Zone 7	10:59 2:21	675 700	75 75	22 21	<1 <1	3 4	Carpeted
18 <sup>th</sup> Floor Zone 7	11:10 2:30	650 700	76 75	22 21	<1 <1	4 1	Carpeted
17 <sup>th</sup> Floor Zone 1	11:10 2:42	750 800	77 76	22 22	<1 <1	8 6	Carpeted
17 <sup>th</sup> Floor Zone 2	11:30 2:49	750 750	77 77	23 22	<1 <1	4 3	Carpeted
17 <sup>th</sup> Floor Zone 3	11:40 2:58	800 825	76 76	22 21	<1 <1	4 3	Carpeted

# Appendix A Continued

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LOCATION	SAMPLE TIME	CARBON DIOXIDE (ppm)	TEMP (°F)	RELATIVE HUMIDITY	CARBON MONOXIDE (ppm)	OCCUPANCY	COMMENTS
17 <sup>th</sup> Floor Zone 4	11:48 3:06	700 675	76 76	22 20	<1 <1	2 1	Carpeted
17 <sup>th</sup> Floor Zone 5	11:57 3:15	750 750	76 77	22 20	<1 <1	1 1	Carpeted
17 <sup>th</sup> Floor Zone 6	12:07 3:23	675 625	76 76	21 19	<1 <1	5 5	Carpeted
17 <sup>th</sup> Floor Zone 7	12:14 3:51	700 625	76 73	21 20	<1 <1	3 3	Carpeted; door open 60 minutes
17 <sup>th</sup> Floor Core	12:22 3:58	700 725	75 74	21 21	<1 <1	2 1	Carpeted

ppm = parts per million

## Appendix B

### Cultureable Fungal Air Sample Results

25 Sigourney Street  
Hartford, CT

April 26, 2001

Sample Number	Location	Fungal ID	Concentration (CFU/m <sup>3</sup> )	Percentage (%)
1	Outside	Cladosporium	14	33
		Epicoccum nigrum	7	17
		Paecilomyces	7	17
		Penicillium	7	17
		Phoma	7	17
		Total: 43		
2	Outside	Aspergillus sp.	7	6
		Basidiomycetes	71	59
		Cladosporium	36	29
		sterile fungi	7	6
		Total: 121		
3	16 <sup>th</sup> Floor Zone 3	sterile fungi	14	100
		Total: 14		
4	16 <sup>th</sup> Floor Zone 4	Penicillium	7	50
		Phoma	7	50
		Total: 14		
5	16 <sup>th</sup> Floor Zone 5	sterile fungi	7	100
		Total: 7		
6	16 <sup>th</sup> Floor Zone 7	sterile fungi	7	100
		Total: 7		
7	15 <sup>th</sup> Floor Zone 6	Penicillium	7	100
		Total: 7		
8	15 <sup>th</sup> Floor Zone 7	Cladosporium	7	50
		sterile fungi	7	50
		Total: 14		
9	14 <sup>th</sup> Floor Core	No Growth	<7	NA
10	14 <sup>th</sup> Floor Zone 5	Aspergillus sp.	7	25
		Cladosporium	14	50
		Syncephalastrum racemosum	7	25
		Total: 28		
11	14 <sup>th</sup> Floor Zone 7	Penicillium	7	100
		Total: 7		



## Appendix B Continued

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Sample Number	Location	Fungal ID	Concentration (CFU/m <sup>3</sup> )	Percentage (%)
F-1	19 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-2	19 <sup>th</sup> Floor Zone 1	No Growth	<7	NA
F-3	19 <sup>th</sup> Floor Zone 3/4	Memnoniella echinata	7 Total: 7	100
F-4	18 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-5	18 <sup>th</sup> Floor Zone 2	Penicillium	7 Total: 7	100
F-6	17 <sup>th</sup> Floor Zone 1	No Growth	<7	NA
F-7	17 <sup>th</sup> Floor Zone 2	Cladosporium	7 Total: 7	100
F-8	17 <sup>th</sup> Floor Zone 3	No Growth	<7	NA
F-9	17 <sup>th</sup> Floor Zone 4	Rhodotorula glutinis yeasts	7 7 Total: 14	50 50
F-10	17 <sup>th</sup> Floor Zone 5	yeasts	7 Total: 7	100
F-11	17 <sup>th</sup> Floor Zone 6	No Growth	<7	NA
F-12	17 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-13	17 <sup>th</sup> Floor Core	Penicillium	7 Total: 7	100
F-14	19 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-15	19 <sup>th</sup> Floor Zone 1	No Growth	<7	NA
F-16	19 <sup>th</sup> Floor Zone 3/4	Cladosporium yeasts	7 7 Total: 14	50 50

## Appendix B Continued

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Sample Number	Location	Fungal ID	Concentration (CFU/m <sup>3</sup> )	Percentage (%)
F-17	18 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-18	18 <sup>th</sup> Floor Zone 2	No Growth	<7	NA
F-19	17 <sup>th</sup> Floor Zone 1	yeasts	7 Total: 7	100
F-20	17 <sup>th</sup> Floor Zone 2	No Growth	<7	NA
F-21	17 <sup>th</sup> Floor Zone 3	Cladosporium	14 Total: 14	100
F-22	17 <sup>th</sup> Floor Zone 4	No Growth	<7	NA
F-23	17 <sup>th</sup> Floor Zone 5	No Growth	<7	NA
F-24	17 <sup>th</sup> Floor Zone 6	Cladosporium	7 Total:	100
F-25	17 <sup>th</sup> Floor Zone 7	No Growth	<7	NA
F-26	17 <sup>th</sup> Floor Core	No Growth	<7	NA
Blank	NA	No Growth	NA	NA

ID = Identification

CFU/m<sup>3</sup> = colony forming unit per cubic meter of air